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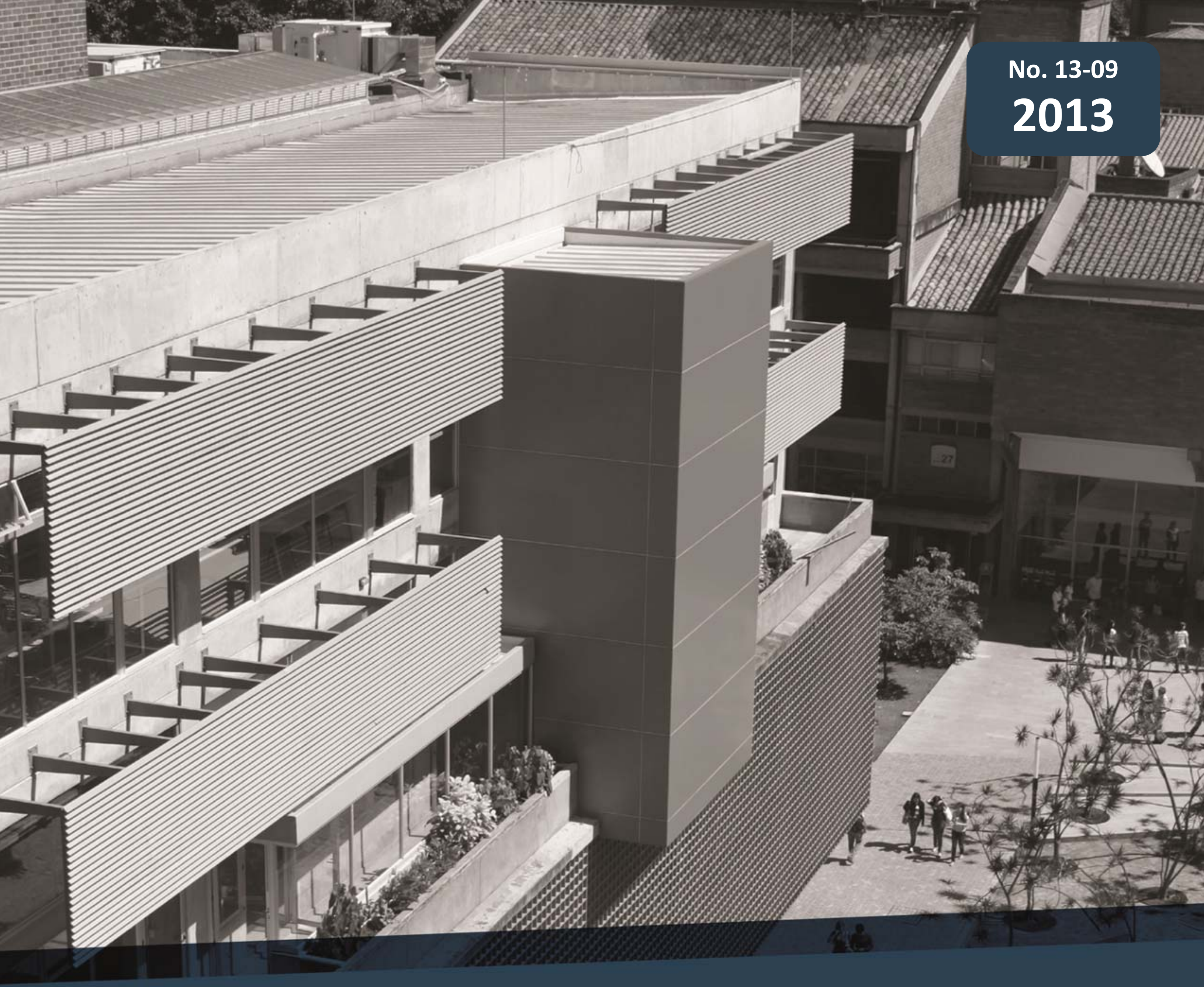

MONETARY POLICY SHIFTS AND THE FORWARD DISCOUNT PUZZLE

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Monetary Policy Shifts and the Forward Discount Puzzle[*]

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Abstract

This paper argues that considerable switches in monetary policy are able to explain a major part of the forward discount puzzle. We build a theoretical model suggesting that violations of the uncovered interest rate parity are owed to shifts in monetary policy from a destabilizing (when the Taylor principle is violated) to a stabilizing regime (when a central bank follows a Taylor-type rule). Following the switch is an “adjustment period” during which forecasters gradually update their expectations, eventually restoring the parity. It is in this adjustment period, when the forward discount puzzle arises. In the second part of the paper we test the model on the Canadian dollar, German mark, and British pound, all against the US dollar. Results indicate that the forward discount puzzle loses significance after allowing for an adjustment period of about 1 − 2 years. Our results are robust to various different specifications, such as the use of different maturities or base currencies. Further, it seems unlikely that our results coincide with contemporaneous events.

JEL Classification: E52, F31, G14
Keywords: expectations errors, excess returns, forward discount puzzle, Taylor rule, monetary policy

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"Just how far Mr. Volcker will go in wielding the monetary sledgehammer is open to question."
Lakeland Ledger (newspaper) on August 19, 1979.

1 Introduction

Although heavily researched, the forward discount puzzle (FDP from here on) still requires pieces to be solved. Forward exchange rates are supposed to be an unbiased predictor of future spot rates, but numerous studies have shown that they are not.[1] The search for possible explanations has been going on for a while, but it appears as if there is not one major cause for the significant deviation from uncovered interest rate parity (UIRP), but rather a combination of reasons is more likely to be the solution, as pointed out by Sarantis (2006) for example. To date, three major explanations of the puzzle exist: (1) a risk premium, (2) infrequent portfolio decisions, and (3) expectations errors.

Considering the first alternative, Froot and Frankel (1989) use survey data to decompose the bias into portions attributed to a risk premium and to expectations errors. Their findings indicate that a risk premium can at best explain a small portion of the puzzle. Subsequently, Engel (1996) provides a good summary of the literature focusing on the risk premium. Although the risk premium explanation has not received much support for a while, more recent papers are reviving its validity, such as Lustig and Verdelhan (2007), Verdelhan (2010) or Alvarez et al. (2009).

The second possible explanation focuses on the frequency of market participants' portfolio decisions. Bacchetta and Wincoop (2005) and Bacchetta and Van Wincoop (2007, 2010) demonstrate that it could be optimal for rational decision makers to manage their portfolio only on occasion, as corresponding fees may be higher than gains from trading more frequently, leading to violations of the UIRP. But if this were the entire solution, a few powerful traders could take advantage of forward excess returns in the long run. Plus, the puzzle would have to exist throughout large sample periods if we assume that the structure of fees remained mostly unchanged. However, several analyses suggest that the FDP is only a temporary phenomenon, as we discuss in more depth below.

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[1] See Froot and Thaler (1990), Lewis (1995), Engel (1996), or more recently Chinn (2006) for summaries. In the following, we use the FDP and violations of the UIRP as synonimous statements, as is common in the literature.

Finally, a third explanation of the FDP focuses on expectations errors. If forecasters calculate the forward exchange rate on the basis of their expectations, those expectations rely on a given set of information. Consequently, if forecasters have an incomplete set of information regarding the determination of the future spot rate, their predictions could be biased. Various studies underline the importance of expectations errors, including Froot and Frankel (1989), Mark and Wu (1998), MacDonald (2002), Gourinchas and Tornell (2004), or Lothian and Wu (2011). Moon and Velasco (2011) and Sakoulis et al. (2010) are more specific in naming a reason for potential expectations errors. Moon and Velasco (2011) attribute the strong predictability of foreign excess returns in the 1980s to changes in forecasting techniques from fundamentalists to chartists in the United States, as discussed in Frankel and Froot (1990). Several other studies also show that the FDP is particularly prevalent in the 1980s, such as Choi and Zivot (2007), Sakoulis et al. (2010), or Lothian and Wu (2011). In particular, Sakoulis et al. (2010) considers shocks to US monetary policy in the early 1980s as a main driver of the violation of UIRP.

Our contribution is twofold. First, we provide evidence that the FDP is a temporary phenomenon that persisted for less than two years in the 1970s and 1980s, narrowing down both the time frame, which was previously suggested (the 1980s), and the amount of break points in the data (see Sakoulis et al., 2010 for instance). Second, we provide a precise explanation of why the UIRP is violated over that short time period: In the 1970s/1980s each major central bank drastically revised their conduct of monetary policy by implementing – either explicitly or implicitly – inflation targeting through adhering to a Taylor-type rule (for details see Clarida et al., 1998). Since these one-time changes were (1) unexpected, (2) potentially non-credible for the public, and/or (3) lead to uncertainty on how to calculate future exchange rates, their forecasting models resulted in expectations errors. In the time following the monetary policy shift, the forward discount bias arises and is slowly closed after forecasters gradually adjust to the new system. Thus, our argument further strengthens the expectations errors hypothesis and also provides evidence for the existence of specific break points, which may be responsible for the resulting expectations errors.

We test this hypothesis by examining four major central banks – the Federal Reserve Bank, the Bundesbank, the Bank of Canada, and the Bank of England – with their corresponding currencies: the U.S. dollar, German mark, Canadian dollar, and British pound. All four central banks have undertaken a drastic switch in monetary policy towards targeting inflation (by applying a Taylor-type rule), albeit at different times, as discussed in Nikolsko-Rzhevskyy (2011). We find that the UIRP is significantly violated for only about 1.5 years following each central bank's policy shift, out of the 33-year observation period in the entire sample. Our results remain consistent for different base countries, several forecast horizons, and a test for an alternative explanation, which might coincide with our theory.

The following section develops an intuitive theoretical framework, describing how forecasters make their decision in determining the forward exchange rate. Section 3 starts with a description of our methodology and data and then proceeds with the empirical part of the paper. Finally, section 4 concludes.

2 The Model

A standard approach to testing the forward discount puzzle (FDP) is to regress foreign excess returns on the "forward discount":[2]

$$s_{t+k} - f_{t|k} = \alpha + \beta \cdot (f_{t|k} - s_t) + \epsilon_{t+k}, \tag{1}$$

where s_{t+k} represents the spot bilateral nominal exchange rate in period $t+k$, $f_{t|k}$ is the forward rate k periods ahead as predicted at time t, s_t stands for the spot rate at time t, and ϵ_{t+k} is a zero-mean error term. Under uncovered interest rate parity – assuming no arbitrage, risk neutrality, and rational expectations – both α and β should be insignificantly different from zero, making $f_{t|k}$ an unbiased predictor of s_{t+k}. A typical result, however, is that β is statistically different from zero, with its point estimate being negative.

How is the forward rate $f_{t|k}$ determined? As an example, consider the CAD/USD exchange rate. At time t the Fed (or the Bank of Canada) announces the implementation of stabilizing monetary policy with the aim to control inflation and to promote growth. In the literature, this is often viewed as adhering to some form of the Taylor rule, which assumes that a central bank adjusts the nominal interest rate in response to deviations of inflation from a constant target

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[2] This formulation of the FDP follows Froot and Frankel (1989, p. 142, equation (2)) and Moon and Velasco (2011).

and output from the trend. Taylor (1993) stresses that in order to run stable monetary policy, a central bank should respond more than one-for-one to inflation, which became known as the Taylor principle. Now what happens after the Fed's announcement? If forecasters determine $f_{t|k}$ in the market, there are two possibilities: (1) the Fed *does* follow an inflation-stabilizing Taylor-type rule, making the forward rate $f_{t|k} = Es^T_{t+k}$ or (2) the Fed *does not* follow a Taylor-type rule and $f_{t|k} = Es^N_{t+k}$.

Why would a forecaster consider Es^N_{t+k}, even though the announcement has been made? One could think of several reasons. For example, forecasters may (a) question the Fed's willingness or capabilities in applying a Taylor-type rule, (b) underestimate the effect of applying a Taylor-type rule or (c) simply be unsure on how to calculate Es^T_{t+k}, since the exact implementation of the novel inflation-targeting policy regime has never been explicitly announced. Normalizing the number of forecasters to one, we can write the forward rate as a function of the representative agent's expectation of the future spot rate as

$$f_{t|k} = p \cdot (Es^T_{t+k}) + (1-p) \cdot (Es^N_{t+k}), \tag{2}$$

where p $(0 \leq p \leq 1)$ stands for the estimated probability of the central bank using a Taylor-type rule. Now assume that our agent updates her forecasts based on her beliefs, which are formed by previous experience (among other things) using Bayesian learning, i.e. past estimates of the interest rate rule. In general, imagine that our agent considers x previous periods when making her prediction of the spot rate in period $t+k$. Let us say that, for instance, the Fed has made a switch to stabilizing monetary policy and has used a Taylor-type rule in i of the past x periods. We can then write $p = p(i)$, where we assume $p_i > 0$, $p(0) = 0$, and $p(x) = 1$. Any other factors affecting the which makes equation 2 more detailed:

$$f_{t|k} = p \cdot \left(Es^T_{t+k}\right) + (1-p) \cdot \left(Es^N_{t+k}\right). \tag{3}$$

One can think of various scenarios as to *how* past periods are weighted (e.g. more weight on more recent periods), so in the following we sketch the simplest version of valuing all past x periods equally. Although in reality the decision process among forecasters might have been different, this should suffice to illustrate the general idea. In the case of equal value to all x past periods, we can then distinguish between 3 possibilities:

1. $i = 0$: In none of the x previous periods was a Taylor-type rule applied by either of the 2 participating central banks. In this case, $f_{t|k} = Es^N_{t+k}$.
2. $0 < i < x$: i of the past x periods have been marked by the Fed and/or the Bank of Canada applying a Taylor-type rule. This is the diversified forward rate of $f_{t|k} = (\frac{i}{x}) \cdot Es^T_{t+k} + (\frac{x-i}{x}) \cdot Es^N_{t+k}$.
3. $i = x$: All x previous periods were marked by the application of a Taylor-type rule, which means $f_{t|k} = Es^T_{t+k}$.

In retrospect we know that all major central banks switched once and never looked back. Thus, only in the second point above would there be confusion as to how the future spot rate will be determined. As long as both participating central banks run consistent monetary policy for at least $x + 1$ periods (either following or not following a Taylor-type rule) the UIRP should hold. It is during the x periods after a policy regime change by either of the banks, in which forecasting models will be mixed, resulting in the FDP. In the following section we proceed to testing this hypothesis.

3 Empirics

3.1 Methodology

We modify equation (1) to allow for 2 separate regimes: the "adjustment" regime following a change in monetary policy, lasting x periods for each central bank involved, and the "normal" regime of constant monetary policy.[3] In particular, we allow β to take on 2 values, specific for each x: $\beta_{1,x}$ during the adjustment period following the break in policy and $\beta_{2,x}$ during normal times of constant monetary policy.

In order to estimate these coefficients, we define a dummy variable D_t which equals 1 following

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[3] Hence, we restrict the adjustment period to be of the same duration for both foreign and domestic central banks. The dates, however, are allowed to differ.

a change in monetary policy:

$$D_t = \begin{cases} 1,\ t_B < t \leq t_B + x & (4) \\ 1,\ t_B^* < t \leq t_B^* + x & (5) \\ 0,\ \text{otherwise} & (6) \end{cases}$$

with t_B and t_B^* being the monetary regime shift dates for the home and foreign central bank. For example, if $t_B = 10$, $t_B^* = 20$ and $x = 18$ months, then $D = 1$ for t ranging from 11 to 38. If instead $t_B^* = 40$, then D would be 1 for $t = \{11, ..., 28\}$ and $t = \{41, ..., 58\}$, but 0 otherwise. For a given adjustment period length x, this results in the following estimable equation:

$$s_{t+k} - f_{t|k} = \alpha_x + \beta_{1,x}(f_{t|k} - s_t) \cdot D_t + \beta_{2,x}(f_{t|k} - s_t) \cdot (1 - D_t) + \epsilon_{t+k}. \tag{7}$$

We hypothesize that there exist some x's for which $\beta_{1,x}$ is significantly different from zero and, based on previous research, likely negative, while $\beta_{2,x}$ is insignificant, meaning the FDP does not exist outside the adjustment time of x periods. The lowest value of $x^* = \min\{x\}$ for which these properties hold will have the meaning of the adjustment period length.

3.2 Data

We use monthly foreign exchange rates for the Canadian dollar, the German mark, and the British pound, with the U.S. dollar being the base currency. Or data ranges from January 1978 to November 2011 and comes from "Global Insight".[4] Table 1 shows descriptive statistics for the case of maturity $k = 3$ months. We are using these four currencies because they have been pointed out to be examples of major independent central banks undergoing a monetary regime change to applying a Taylor-type rule, as described in Clarida et al. (1998) and Nikolsko-Rzhevskyy (2011). In particular, the following break point dates have been identified:

- Canada: January 1988

  This is when John Crow, governor of the Bank of Canada, explicitly set price stability as the Bank's primary goal in his Hanson Memorial Lecture at the University of Alberta. As Gordon Thiessen, another former Bank of Canada governor, noted in 2000, "The Hanson

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[4] German data stops in December 1998 due to the introduction of the Euro on January 1, 1999. Exchange and forward rates are midpoint averages.

lecture contained probably the strongest commitment to price stability that had ever come from the Bank of Canada." (Nikolsko-Rzhevskyy, 2011, page 887).

- Germany: March 1979

  Germany entered the European Monetary System (EMS) at the beginning of 1979, which is normally considered as a start of a new monetary regime (Clarida et al., 1998, page 1044). The same date is used in Molodtsova et al. (2008, page S67) and Nikolsko-Rzhevskyy (2011, page 889).

- U.K.: June 1979

  This is when Margaret Thatcher came to power and announced the Medium Term Financial Strategy (MTFS) with its main goal to control inflation, as suggested by Clarida et al. (1998, page 1054) and Nikolsko-Rzhevskyy (2011, page 891).

- U.S.: August 1979

  That month Paul Volcker was appointed as the new Federal Reserve Board Chairman, who then managed to end the Great Inflation and stabilize prices (see Nikolsko-Rzhevskyy, 2011, page 883). The same breakpoint (the 3rd quarter of 1979) is also used in Orphanides (2004, page 161).[5]

With these break points in mind, we now turn to testing our theory using regression analysis.

3.3 Results

Table 2 presents full sample estimates of equation (1) for maturity $k = 3$ as a representative case for the FDP. Two out of three currencies, the Canadian dollar (CAD) and the German mark (DM), show a violation of the UIRP with a negative and significant β. For the British pound (GBP), the coefficient is not statistically significant, albeit also negative. We complement this regression output with the variance ratio test, rejecting the random walk null of no predictability at all conventional levels of significance.

Table 3 displays our main results from estimating equation (7), where we distinguish between β_1 (the coefficient of the forward discount during the adjustment period) and β_2 (the coefficient of

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[5] Using October 1979 as an alternative break point as suggested in Clarida et al. (1998, page 1042) does not change the significance of our results.

the forward discount outside the adjustment period). We estimate two representative regressions for each currency: one allowing forecasters $x = 18$ months to correct their expectations (columns $1-3$) and another one giving them $x = 36$ months (columns $4-6$). In addition, figures (1a) – (1c) show both coefficients with the two-sided 5% confidence bands for possible adjustment periods between $x = 6$ and $x = 60$ months to illustrate the process of getting used to the new monetary policy regime.

Columns (1) and (4) in table 3 consider the CAD/USD exchange rate, showing that for both adjustment periods β_1 is highly significant, whereas no forward discount puzzle exists outside this period. Figure (1a) displays different lengths of adaptation in months, measured on the x-axis, and the corresponding values for β_1 and β_2 (with 5% two-sided confidence intervals) along the y-axis for the Canadian dollar. β_2, displayed by the dotted line, is insignificant and remains so after increasing x up to 60 months. Further, the forward discount β_1, displayed by the solid line, is consistently significant for adjustment periods between 15 and 56 months.

Columns (2) and (5) display regressions for the DM/USD rate. Our expectations are confirmed on both the 18 and 36 month horizon: the forward discount during the adaptation period is significant, whereas there is no significance outside this period. Along with these results, figure (1b) displays different lengths of adjustment for the German mark. The forward discount is not significant outside the adjustment period (β_2) when allowing forecasters at least 13 months to adjust. The lowest x for which β_1 is consistently significant is about 32 months.

Finally, columns (3) and (6) display results for the GBP/USD exchange rate. Recall that we do not find a significant forward discount for the full sample from $1978-2011$ (table 2), suggesting that the puzzle may not exist for the British currency. However, when recognizing the break points in monetary policy for the Bank of England and the Fed, we do find that the puzzle exists in the months after. For adjustment periods of 18 and 36 months, β_1 is highly significant but β_2 is not. Figure (1c) confirms our theory: the forward discount is strongly significant after central banks (in this case the Fed and the Bank of England) changed their monetary policy – a result that is robust for adjustment periods in between 15 and 60 months. Outside this adaptation period there is no puzzle, as displayed by β_2.

In summary, the main results confirm our theory for all three currencies: the forward discount disappears once we allow for an adjustment period of about $1-2$ years after central banks switch to following an application of the Taylor rule. The following section performs several robustness checks.

3.4 Robustness Checks

The following sections display various robustness checks of our main results. Specifically, we consider whether our results are driven by (1) the maturity of the forward rate, (2) the base currency, or (3) an alternative hypothesis in which U.S. forecasters switch from analyzing fundamentals to charts (as suggested by Moon and Velasco, 2011).

3.4.1 Using different maturities

So far, we have looked at the forward rate with a $k = 3$ month maturity rate, but do these results hold when using different maturities? Figures 2 – 4 display our main results for $k = 1$, 6, and 12 month maturities for adjustment period lengths up to $x = 60$ months.

Figures (2a) – (2c) look at the 1 month maturity for the CAD/USD, DM/USD, and GBP/USD exchange rates. In all cases, we observe that there exists no forward discount after only allowing forecasters an adjustment period of a few months. β_1 on the other hand is significant for most possible adjustment periods up to 60 months for the CAD and the GBP. Only for the DM do we observe a bumpier process of adjustment as shown by figure (2b). This suggests that the adjustment was not always smooth everywhere and potentially that other reasons might have contributed to the FDP in this instance. Figures (2d) – (2f) and (2g) – (2i) depict graphs for the 6 and 12 month forward rate. Throughout all three currencies (with GBP/USD results being somewhat weaker), there exists no FDP when allowing forecasters about 18 – 48 months to get used to the new regime. The only result which is somewhat off with the rest is the British pound in figure (2i) that suggests a significantly longer adjustment period of almost 5 years.

3.4.2 Using different base currencies

To test whether our results are in any way driven by the fact that all our exchange rates are measured against the USD, we now look at what happens if we express all exchange and forward rates in terms of the CAD or the GBP.

Figures (3a) and (3b) display 3 month forward rates of the DM and the GBP, both against the CAD.[6] Figure (3a) confirms our theory: β_1 is significantly different from zero after allowing for $x = 11$ months to adjust and β_2 is insignificant outside the adjustment period. The British pound in figure (3b) takes a little longer to react, since only after allowing for 23 months do our results hold up. After that β_2 becomes and stays insignificant.

Figure (3c) shows results for the DM when using the British pound as a base currency.[7] While β_1 is highly significant as expected, β_2 is only on the verge of insignificance. One explanation why the DM/GBP rate may behave somewhat differently from other exchange rates could be the special relationship between the Bundesbank and the Bank of England: between October 1990 and September 1992, the Bank of England was a part of the European Exchange Rate Mechanism, thus not being independent from the Bundesbank.

Overall, violations of the UIRP do not seem to be driven by the Fed only, but rather by changes in monetary policy of all central banks in question.

3.4.3 Using only the U.S. break point

Our theory is crucially based on the definition of break points. Since we are only looking at major central banks (the Fed, the Bank of Canada, the Bundesbank, and the Bank of England), we assume that monetary policy switches to applying a Taylor-type rule on both sides of an exchange rate play a decisive role. In another theory, Moon and Velasco (2011) attribute the FDP to a change in forecasting techniques by U.S. forecasters from 1980 – 1987 and assume a single 8-year-long adjustment period. Since the Fed's change in monetary policy (August 1979) falls right before this time period, our findings could just happen to coincide with this switch in forecasting techniques. Judging from the previous robustness check, however, this is unlikely to be the case since our results with alternative base currencies still receive support. Another way to test this is to reestimate our model, allowing for *one* break point only. Since the break points for Germany and the U.K occurred within 8 months from the Fed's regime change, it makes sense to look at the CAD/USD rate, as the Canadian break point falls outside the 1980 – 1987 timeframe suggested by Moon and Velasco (2011). The CAD regime change occurred in

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[6] The USD against the CAD returns the equivalent to figure (1a).

[7] The graphs for US/GBP and CAD/GBP are equivalent to figures (1c) and (5b).

January 1988. Figure (3d) shows β_1 and β_2 when only allowing for the Fed's break point in the CAD/USD exchange rate. Notice that we extend the time frame displayed up to 120 months here, mimicking Moon and Velasco (2011). There is no difference in terms of significance if we look at the time during or outside the adjustment period: both β_1 and β_2 are insignificant for up to 89 months.

In summary, our results do not seem to be driven by the maturity of the forward rate or the base currency. Further, it seems unlikely that our results coincide with another explanation as regime changes by both participating central banks seem to play a role in creating the FDP.

4 Conclusion

This paper argues that a major cause of the forward discount puzzle (FDP) – the violation of the uncovered interest rate parity (UIRP) – are switches by central banks from a destabilizing regime (not using a Taylor-type rule) to a stabilizing regime (following a Taylor-type rule). First, we develop a model relating these regime changes to the forward discount puzzle. After a central bank switches to using a Taylor-type rule, forecasters fail in predicting the exchange rate and need time to adjust to the new regime. This period of adaptation is when the forward discount puzzle emerges. Our empirical part confirms this theory examining the Canadian dollar, the German mark, and the British pound, all against the U.S. dollar. Indeed, the UIRP is only significantly violated during the adjustment periods of about 1 – 2 years following the regime changes by *both* respective central banks. The forward discount puzzle is not significant outside the adjustment periods. Our results are robust to using different maturities and base currencies. Further, using only *one* break point for an exchange rate and neglecting the regime change by the opposite central bank does not seem sufficient. This substantially weakens the possibility of our explanation coinciding with any other contemporary events.

Our results provide additional evidence for the expectations errors hypothesis, one of the most prominent potential explanations for the forward discount puzzle. By naming and testing a specific reason for why expectations are biased – major regime switches to applying a Taylor-type rule – this result adds another piece to solving the forward discount puzzle.

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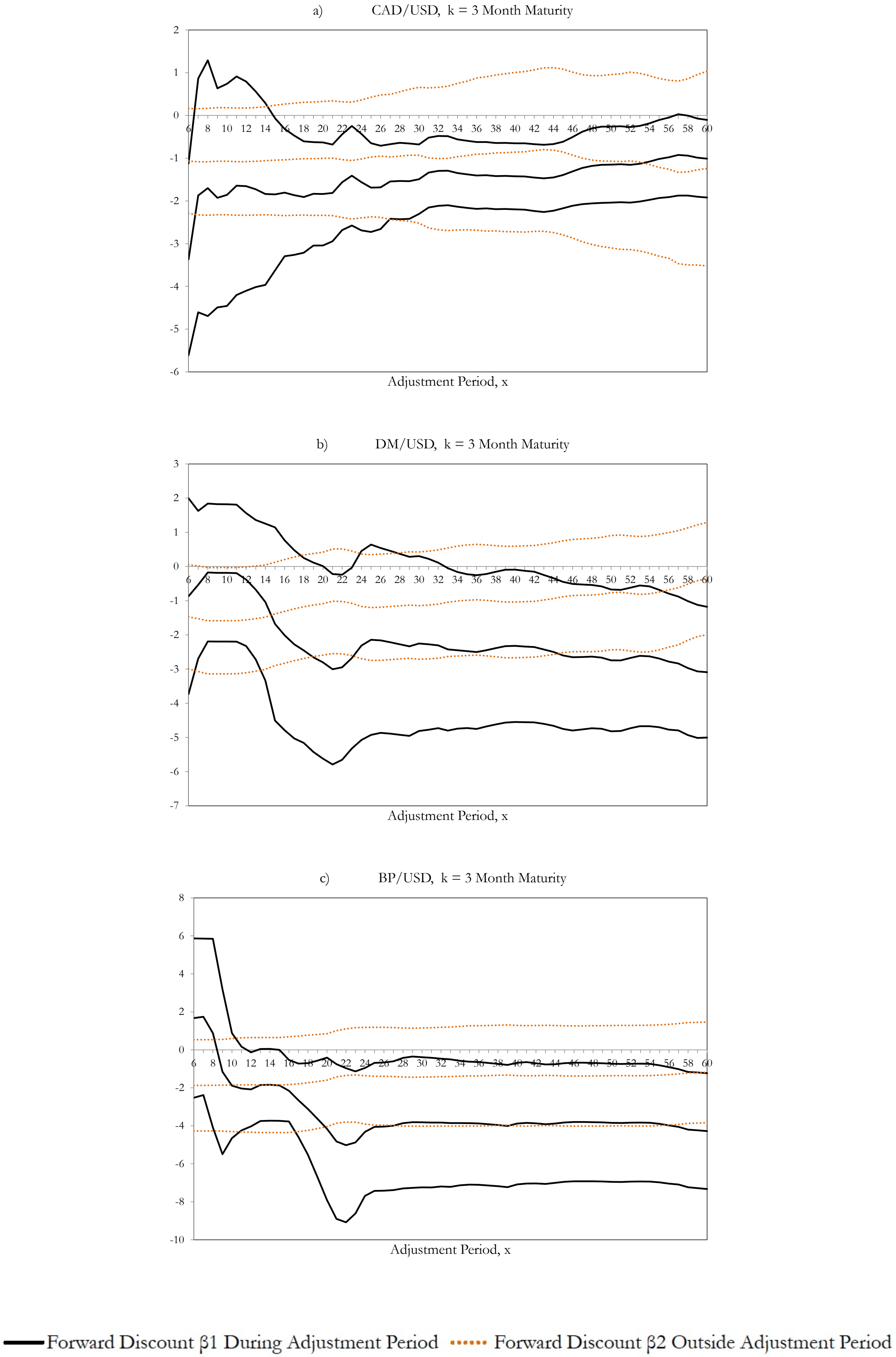
a) CAD/USD, k = 3 Month Maturity

b) DM/USD, k = 3 Month Maturity

c) BP/USD, k = 3 Month Maturity

Figure 1: Using Different Base Currencies or Only the U.S. Break Point

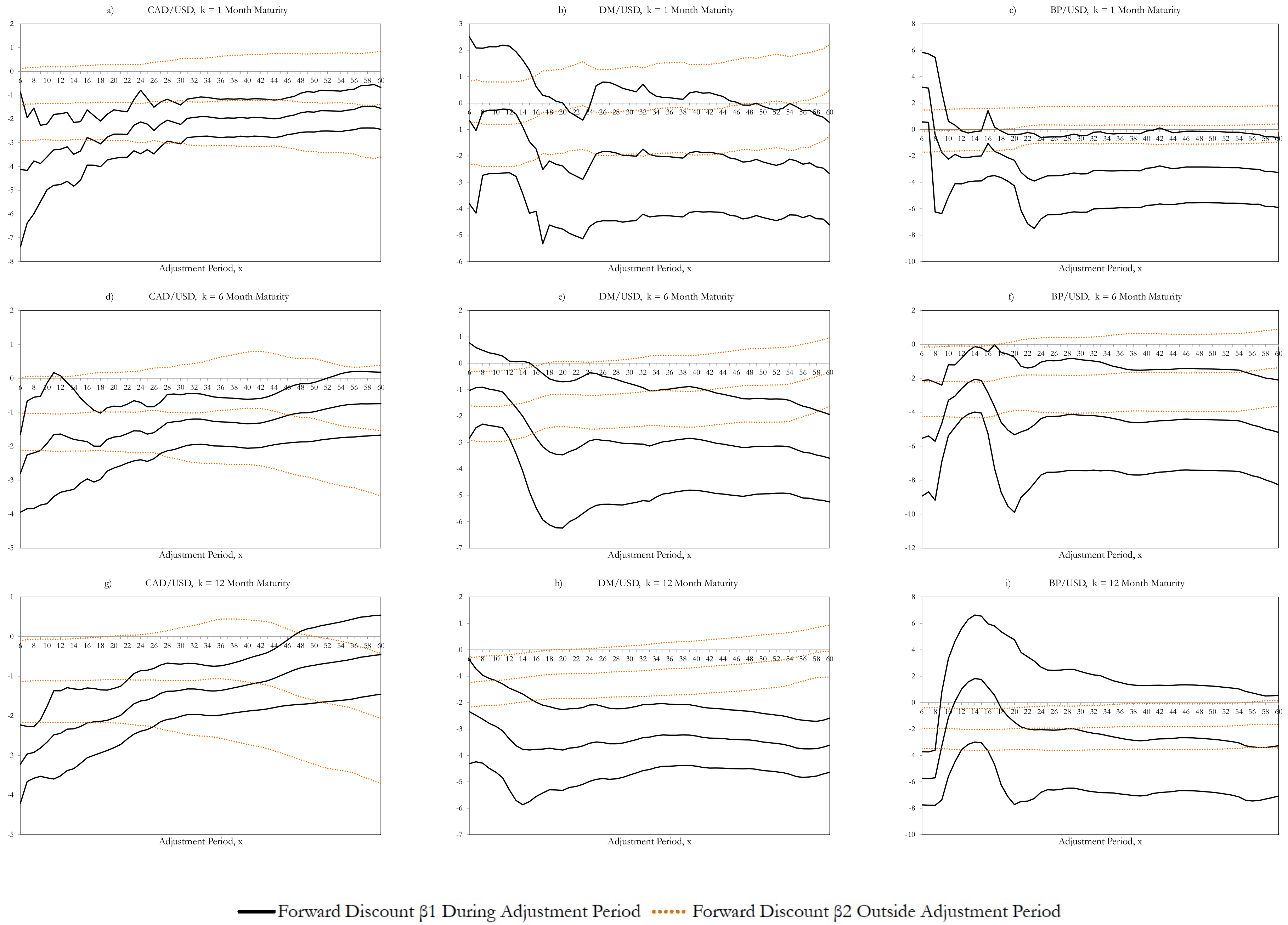

Figure 2: Using Different Maturities

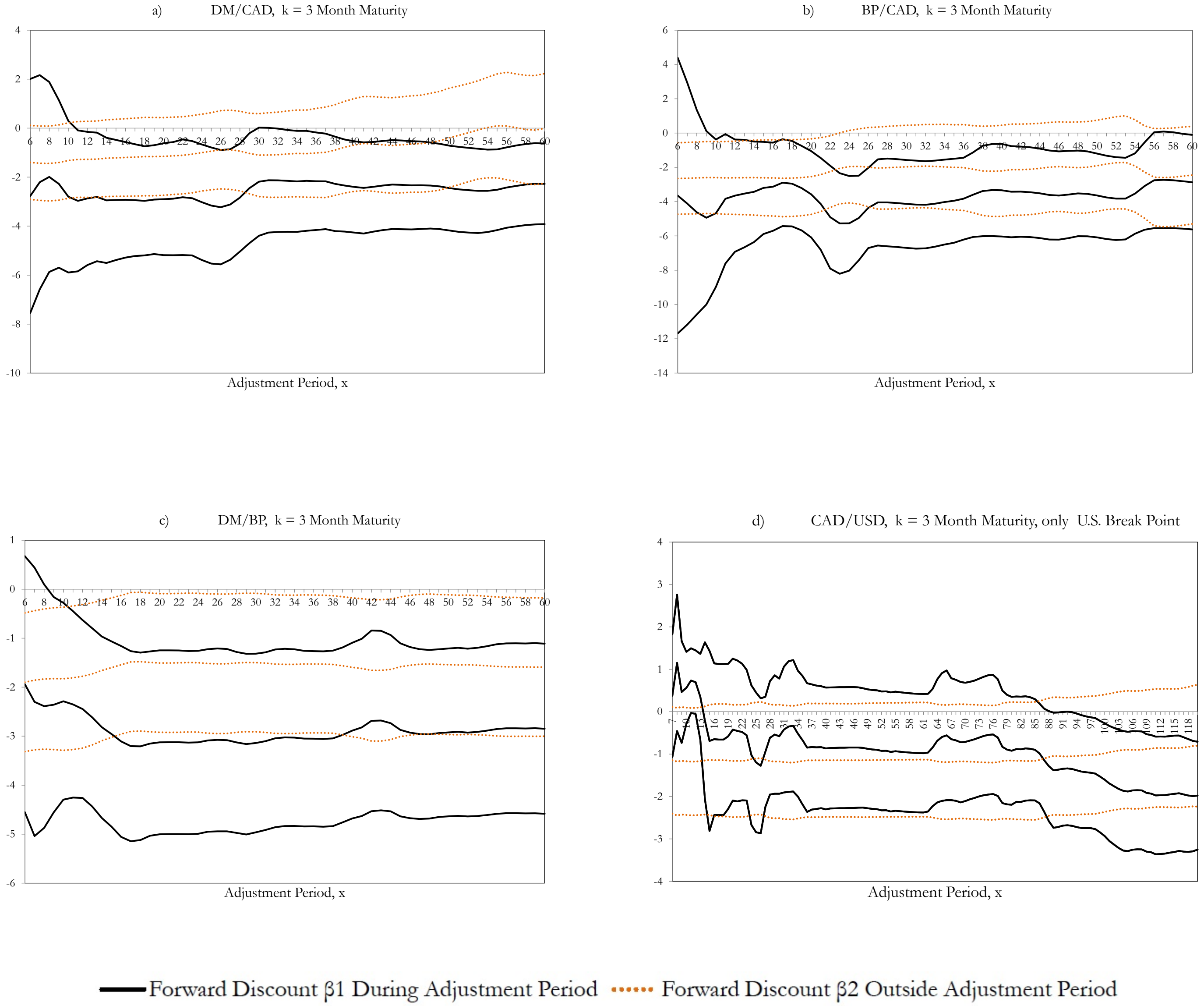

Figure 3: Using Different Base Currencies or Only the U.S. Break Point

Table 1: Summary Statistics ($k = 3$-month maturity)

	Mean (Std. Dev.)	Sample Period	Observations	Break Point
Canadian dollar				January 1988
Foreign excess Returns $s(t+k) - f(t\|k)$	-0.0023 (0.0307))	January 1978 – November 2011	404	
Forward discount $f(t\|k) - s(t)$	0.0017 (0.0040)	January 1978 – November 2011	404	
German mark				January 1979
Foreign excess Returns $s(t+k) - f(t\|k)$	0.0026 (0.0587)	January 1978 – December 1998	248	
Forward discount $f(t\|k) - s(t)$	-0.0051 (0.0082)	January 1978 – December 1998	248	
British pound				June 1979
Foreign excess Returns $s(t+k) - f(t\|k)$	-0.0027 (0.0543)	January 1978 – November 2011	404	
Forward discount $f(t\|k) - s(t)$	0.0041 (0.0060)	January 1978 – November 2011	404	
US dollar				August 1979

Notes: Break points indicate the respective central bank's switch in monetary policy (please see section 3.2 for details). The source of data is "Global Insight." Data for Germany stops in December, 1998 due to the introduction of the Euro on January 1, 1999.

Table 2: Full Sample Results, $k = 3$ month maturity

	(1) Canadian dollar	(2) German mark	(3) British pound
Dependent variable : *foreign excess returns*, $s(t+3) - f(t\|3)$			
Constant	-0.000	-0.005	0.005
	(0.003)	(-0.007)	(0.005)
Forward discount	-1.111*	-1.429*	-1.854
$f(t\|3) - s(t)$	(0.620)	(0.742)	(1.225)
Variance ratio test	3.106	4.664	5.033
P-value	0.006**	0.000**	0.000**
R^2	0.021	0.040	0.042
Observations	404	248	404

Notes: * and ** indicate significance at the 10 and 5 percent level. Newey-West corrected standard errors are in parentheses. All exchange rates are measured against the U.S. dollar. p-value for the variance ratio test for foreign excess returns are obtained using the wild bootstrap method as recommended by Kim (2006).

Table 3: Results for $x = 18$ and $x = 36$ months of adjustment

	(1)	(2)	(3)	(4)	(5)	(6)
	Canadian dollar (18 months)	German mark (18 months)	British pound (18 months)	Canadian dollar (36 months)	German mark (36 months)	British pound (36 months)
Dependent variable : *foreign excess returns*, $s(t+3) - f(t\|3)$						
Constant	-0.001	-0.005	0.005	-0.000	-0.006	0.003
	(0.003)	(0.007)	(0.007)	(0.003)	(0.007)	(0.005)
Forward discount during adjustment period, β_1	-2.065**	-2.322*	-2.779**	-1.431**	-2.492**	-3.912**
	(0.798)	(1.203)	(0.931)	(0.412)	(1.052)	(1.632)
Forward discount outside adjustment period, β_2	-0.999	-1.179	-1.776	-0.901	-0.899	-1.359
	(0.671)	(0.802)	(1.287)	(0.865)	(0.885)	(1.349)
R^2	0.023	0.046	0.043	0.023	0.056	0.054
Observations	404	248	404	404	248	404

Notes: * and ** show significance at the 10 and 5 percent level. See also notes to Table 2.